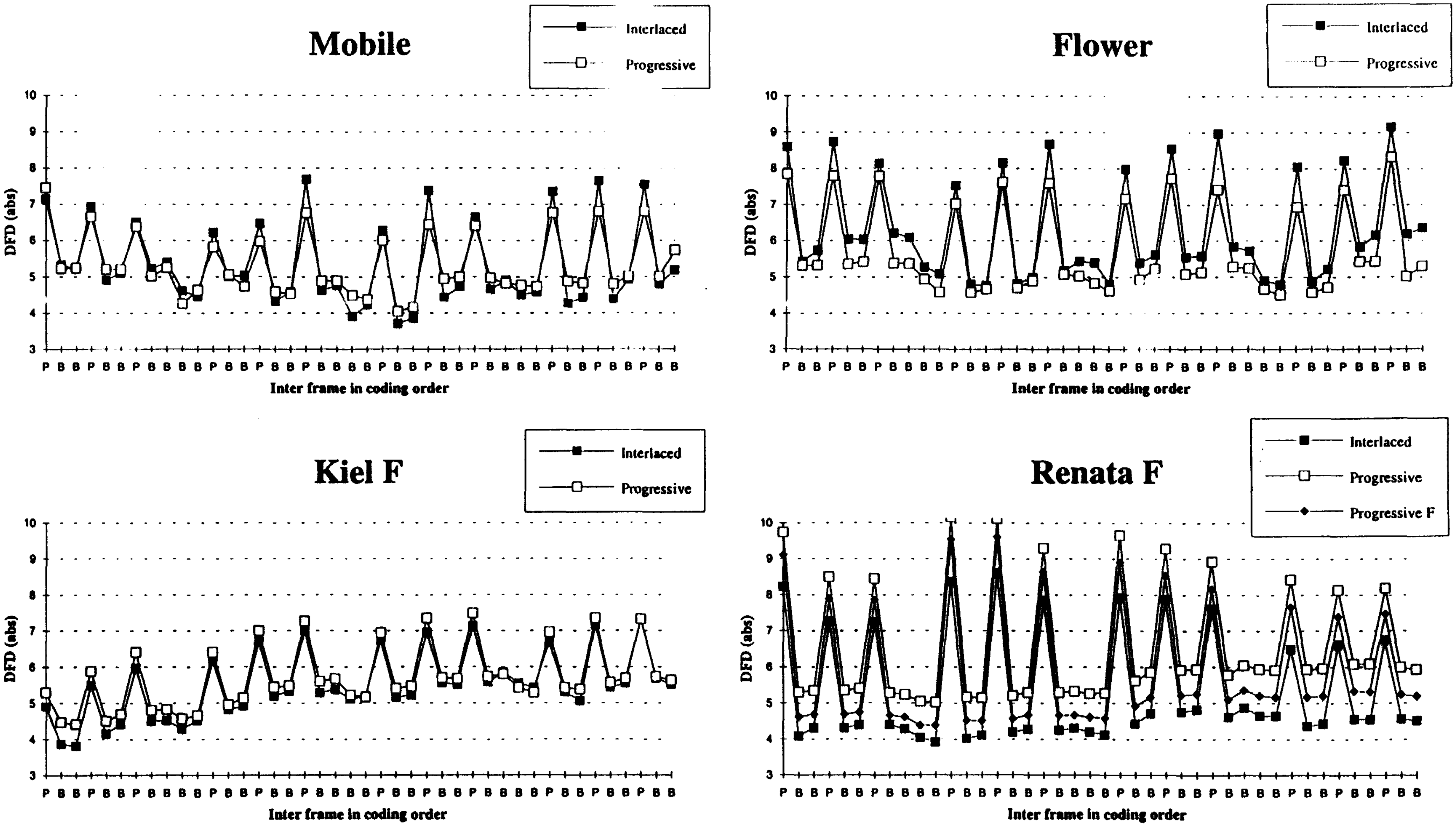


Fig. 6 - Motion compensated DFD

4.5 Coding Gain

From the previous analysis, it is not possible to draw a clear conclusion. The object of this chapter is to measure the overall differences between both formats by means of bit-rate measurements. Considering that the double number of pels has to be transmitted with the progressive format, that both scanning modes have at least similar spatial correlation and motion prediction capabilities, what is the bit-rate required for both format when the same quantization step is used ?

4.5.1 Interlaced versus Progressive

The most important statistical measure is the bit-rate required for interlaced and progressive pictures quantized with the same step size. It means what is the bit-rate required to have the same coding degradation in both cases ? Therefore, the coding gain is introduced and defined as the ratio of the bit-rate required for progressive pictures over the bit-rate for interlaced pictures at the output of the respective encoders. The considerations which led to the adoption of this trial are detailed in chapter 4.1.

For the simulations, the quantizer scale code is set to values leading to a bit-rate near 4 Mbit/s in the same interlaced case (Cf. table 1), but also to a similar picture quality for each sequence (*Mobile* is difficult and requires 6 Mbit/s to be similar to the others). These values have been obtained by a first encoding of the different sequences with the bit-rate control on.

	Mobile	Flower	Kiel	Renata
I Frame	5	9	7	6
P Frame	8	12	10	9
B Frame	14	20	15	13
Bit-rate (Mbit/s)	6	4	4	4

Table 1 - Quantizer scale codes used

Then, the coding gain has been computed for the four first sequences, and plotted in Figure 7. In addition, the averaged values are drawn in table 2. Previous considerations on chapters 4.3 and 4.4 are useful to explain the differences :

• ***Interlaced original pictures*** :

1)- Without motion (*Mobile*), the pictures are frame coded, the spatial correlations and the motion performances are similar for both formats. The double number of pels of the progressive leads to a coding gain near 2.0 for I frames. The double number of vectors for progressive compared to interlaced frame coded pictures leads to a coding gain near 2.0 for B frames (for B frames the bit-rate required for the motion vectors is 50% to 60% of the total bit-rate). The coding gain for the P frames is lower than for the B frames, because the motion estimator performs better than in interlace, and the bit-rate required for the motion vectors is less important;

2)- With motion (*Flower*), the pictures are field coded. The number of motion vectors is the same in both case (2 fields vectors are transmitted per macroblock). It can thus be expected to have a coding gain near 1.0 for the B frames. Progressive performs slightly better for the motion prediction, the coding gain is expected to be lower than 2.0 for the P frames (the motion vector bit-rate is low compared to the DCT coefficients for P frames). Finally, the resolution and spatial correlations are the same for both formats, the coding gain for I frames should be near 2.0;

- *Progressive original pictures* :
  For *Renata* and *Kiel* the same conclusions are valid. I frames requires twice the bit-rate in the progressive case (this is confirmed by the *Renata* F curve, when filtered the coding gain is lower than 2.0). P frames depends on the prediction performances (slightly better for *Kiel*), and for B frames the high quality of the prediction, and the fact that the main bit-rate is due to the motion vectors (with the same number of vectors for both formats) lead to coding gain values near 1.0. This is not the case for the end of the sequence *Renata*, because the motion range is lower at the end, thus interlaced pictures are frame coded, and the number of vectors divided by two. The coding gain is thus nearly multiplied by 2, and previous conclusions on non moving pictures are still valid for I and P frames.

	Mobile	Flower	Kiel	Renata
Coding Gain	1.71	1.16	1.32	1.69

Table 2 - Mean coding gain values

4.5.2 Influence of the Increased Vertical Resolution

At first sight, the main conclusion which can be drawn from the previous chapter is that progressive pictures require more bits than interlaced ones. One assumption is that this is because of the increased vertical resolution, in other words the coding gain is computed between pictures with different vertical resolutions. To check that, the coding gain is computed on one sequence (*Renata*) between the interlaced version and the original progressive source after Kell filtering to reach the same definition as the interlaced one. The result plotted in table 3, shows that the coding gain is better when the source is filtered (1.44 instead of 1.69) and this 0.25 improvement seems valid for all the sequences.

	Progressive	Progressive Filtered
Coding Gain	1.69	1.44

Table 3 - *Renata*, mean coding gain values with and without filtering

Thus, progressive scanning of pictures requires twice the raw bit-rate of interlaced before compression, and between 1.1 and 1.7 after MPEG-2 encoding with a higher vertical resolution, otherwise an additional gain of 0.25 is expected.

In addition, the previous distinctions can be done to give the following classifications on the bit-rate required to transmit progressive signals encoded with the same quantization step as their corresponding interlaced signals :

-Sequences with similar vertical resolution (deinterlaced or *Renata F*) :

With motion : coding gain for I frames : 1.7;
P frames : 1.3 to 1.6;
B frames : 1.0 to 1.2;

Progressive allows to transmit twice the number of lines with nearly the same bit-rate as the interlace;

Without motion : coding gain for I frames : 1.8 to 2.0;
P frames : 1.4 to 2.0;
B frames : 1.5 to 2.2;

Progressive allows to transmit twice the number of lines with less than twice the bit-rate of the interlace;

-Sequences with different vertical resolution (progressive pictures) :

With motion : coding gain for I frames : 1.8 to 2.0;
P frames : 1.6 to 1.8;
B frames : 1.0 to 1.5;

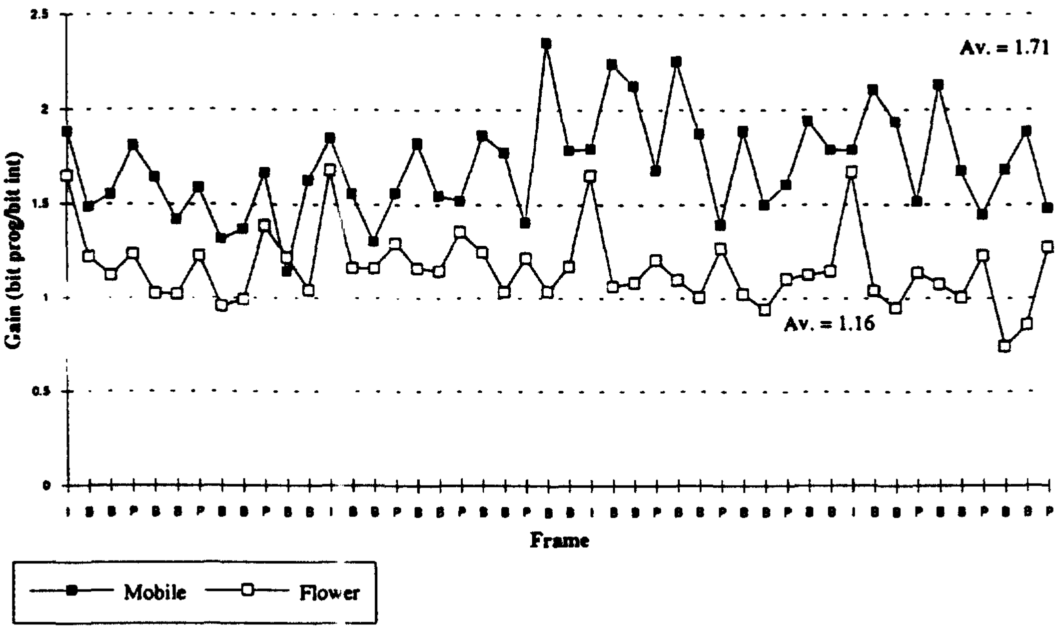
Progressive allows to transmit twice the number of lines with less than twice the bit-rate of the interlace;

Without motion : coding gain for I frames : 2.3;
P frames : 1.5 to 2.4;
B frames : 1.5 to 2.0;

Progressive requires twice the bit-rate of the interlace to transmit twice the number of lines;

If it is agreed that this is the worst case for progressive scanning because a non optimal GOP structure has been simulated, and that the same quantizer step size leads probably to a better picture quality when progressive display is used, then, at the same bit-rate, similar picture quality can be expected with progressive scanning in main cases. This will be verified in the next chapter by processing each sequence with the bit-rate control on, that is by considering the same transmission channel.

Coding gain (constant Q)



Coding gain (constant Q)

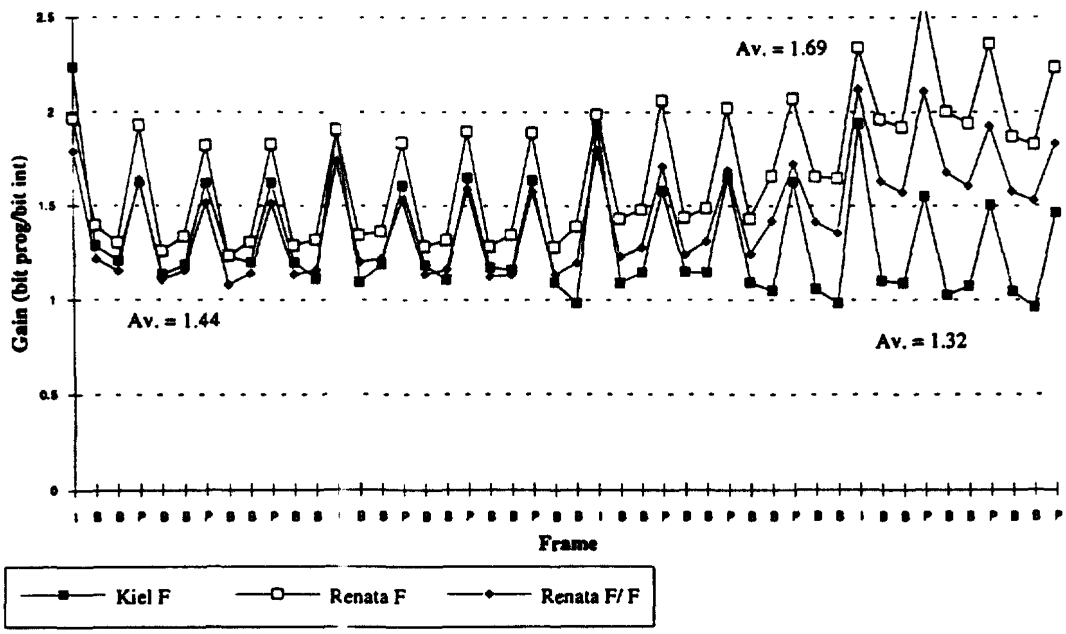


Fig. 7 - Coding Gain

5 - Coding Efficiency of Both Interlaced and Progressive Formats

For the simulations the scenario depicted in figure 8 has been used : two different broadcasting chains have been developed, an interlaced and a progressive one. For each one progressive or interlaced source materials are used with the corresponding scanning format conversion when necessary.

The first results concern the Peak Signal to Noise Ratio (PSNR) defined as follows :

$$PSNR_{dB} = 10 \times Log_{10}\left(\frac{255^2}{\frac{1}{N_i \times N_j}\sum_{i=1}^{N_i}\sum_{j=1}^{N_j}\left|S(i,j) - D(i,j)\right|^2} \right)$$

Where $S(i,j)$ is the source pixel at location (i,j), and $D(i,j)$ the corresponding one in the decoded picture of size $N_i \times N_j$.

These measures, computed between identical formats, do not assess the subjective picture quality, but they are an indicator of the differences between two different sequences of the same format. If different scanning formats are compared the influence on the PSNR is important, thus careful attention has to be paid, and subjective analysis is recommended.
Two bit-rates have been selected (6 Mbit/s for *MOBILE* and 4 Mbit/s for the other sequences) in order that the picture quality over the whole set of sequences is constant (PSNR between 30 and 35 dB).
In addition a subjective expertise is provided, because progressive display is supposed to be more pleasant than interlaced.

PSNR values and subjective picture evaluation are useful to compare both transmission formats, but complementary results are provided to check which format is better and for what bit-rates. In the same way, simulations with different picture quality at the same bit-rate will show the effect of the picture complexity on the scanning format efficiency. Finally, the influence of the deinterlacing process is also analyzed because interlaced sources are used for both transmission chain.

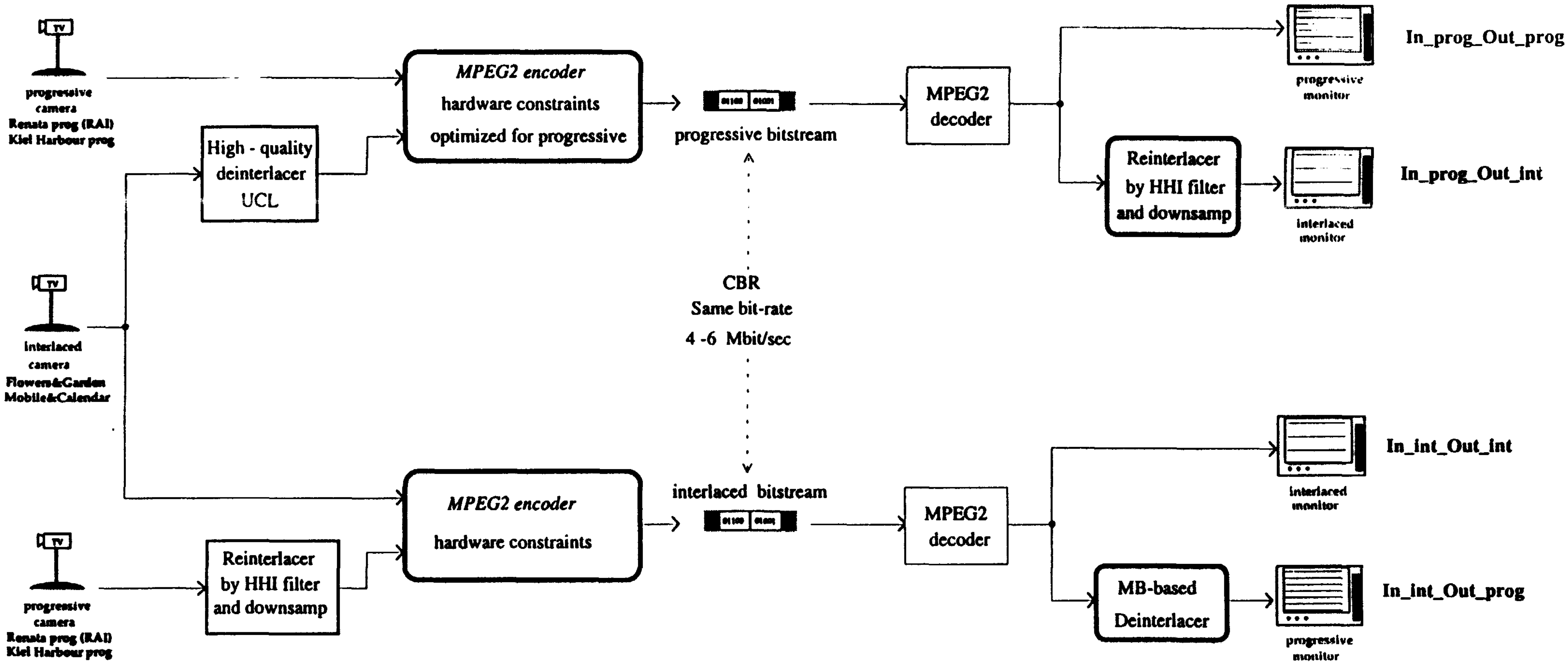


Fig. 8 - Interlaced and Progressive transmission formats

5.1 MPEG-2 Encoding Parameters

The same parameters as in the previous chapters are used, except the GOP structure. For interlaced signals the classical one is used (M=3, N=12). However, for progressive pictures, two possibilities have been discussed :
The first one considers a GOP structure twice that of the interlaced case, which means M=6, N=24 (figure 9-b) to have the same temporal spacing between P frames for both formats. The second one is computed to have a lower temporal distance between P frames to improve the temporal prediction, it leads to M=5, N=25 (figure 9-a).

The choice was done after software simulations, and the last one appears to be slightly more efficient than the first one.
Consequently, for the following simulations, M=5, N=25 was used.

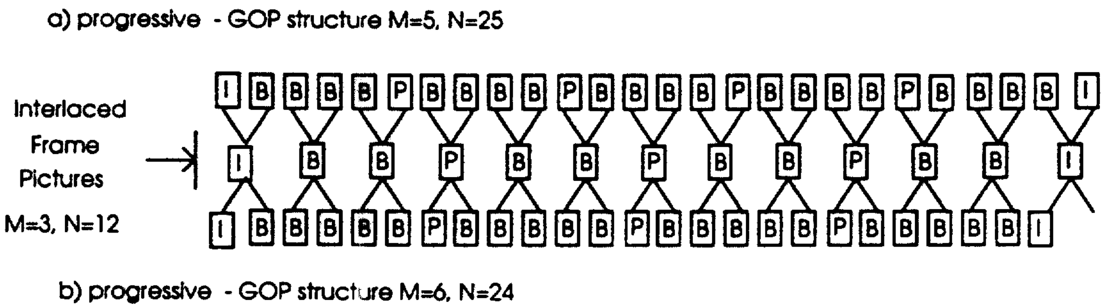


Fig. 9 - GOP structure used

5.2 Coding Efficiency Comparisons

5.2.1 PSNR Measures

Four different outputs have been processed for each input sequence yielding four different PSNR values (two progressive and two interlaced PSNR). In figures 10 to 13 these PSNR values are plotted for the luminance component and each source sequence. In each graph the curves represent one of the four following broadcasting options :

- *Int_Int* : Interlaced encoding and display = *In_int_Out_int* figure 8;
- *Prog_Int* : Progressive encoding and interlaced display = *In_prog_Out_int* figure 8;
- *Int_Prog* : Interlaced encoding and progressive display = *In_int_Out_prog* figure 8;
- *Prog_Prog* : Progressive encoding and display = *In_prog_Out_prog* figure 8.

The mean values are summed up in tables 4 and 5, for interlaced and progressive display respectively.
When two sequences with the same display format are used, a better PSNR value generally means a better picture quality. If the display format is not the same, it should

be taken into account that progressive display leads to a more pleasant picture quality. Consequently a lower PSNR value in progressive does not necessarily mean a lower picture quality.

From these statements the following conclusions can be drawn for each display format :

• **Interlaced display :**

	Mobile		**Flower**		**Kiel**		**Renata**	
Coding Format	Prog	Int	Prog	Int	Prog	Int	Prog	Int
PSNR (dB) Y	29.32	32.30	30.38	30.64	32.11	31.61	33.49	33.14
PSNR (dB) U	33.90	34.45	33.47	33.39	39.08	39.23	36.07	35.69
PSNR (dB) V	31.85	32.11	31.87	31.38	37.82	38.00	37.86	37.67

	Foot[1]		**Kiel 2[1]**		**Pendel[1]**		**Pops[1]**	
Coding Format	Prog	Int	Prog	Int	Prog	Int	Prog	Int
PSNR (dB) Y	32.23	30.84	29.17	27.81	41.25	41.87	36.35	36.99
PSNR (dB) U	...	...	....	....	....	....	....	....
PSNR (dB) V	...	....	....	....	....	....	....	....

Table 4 - PSNR (dB) for interlaced signals

Progressive coding leads to better performances (PSNR and picture quality) for 4 sequences over 8 (*Kiel, Renata, Foot, Kiel 2*). For two of the other sequences (*Flower* and *Pendel*) the visual quality is in favor of the progressive format, confirming that the PSNR difference is too low to be significant (less than 0.3 dB). *Pops* is visually similar (difference equal to 0.6 dB), and the last one (*Mobile*) performs better when interlaced coded (1 dB more).
Thus from the PSNR point of view, the two formats are similar (average PSNR : 0.17 dB in favor of the progressive format), except when the deinterlacing failed.

• **Progressive display :**

	Mobile		**Flower**		**Kiel**		**Renata**	
Coding Format	Prog	Int	Prog	Int	Prog	Int	Prog	Int
PSNR (dB) Y	31.30	27.51	31.41	26.59	30.36	26.10	31.12	27.18
PSNR (dB) U	34.26	33.28	34.10	33.68	40.47	39.21	35.55	34.24
PSNR (dB) V	32.29	31.44	32.30	30.83	39.15	37.85	37.47	36.32

Table 5 - PSNR (dB) for progressive signals

The only conclusion from the previous table is that the macroblock based deinterlacer does not perform very well. It means that very simple solutions can not be used, and that careful design should be done to reach an acceptable quality.

[1] UCL scheme [5]

• **Interlaced chain / Progressive chain :**

In this scenario an all progressive chain is compared to an all interlaced one, i.e. interlaced encoding and display compared to progressive encoding and display.

	Mobile		**Flower**		**Kiel**		**Renata**	
Coding Format	Prog	Int	Prog	Int	Prog	Int	Prog	Int
PSNR (dB) Y	31.30	32.30	31.41	30.64	30.36	31.61	31.12	33.14
PSNR (dB) U	34.26	34.45	34.10	33.39	40.47	39.23	35.55	35.69
PSNR (dB) V	32.29	32.11	32.30	31.38	39.15	38.00	37.47	37.67

Table 6 - PSNR (dB) for progressive / interlaced broadcasting

From these figures interlace seems better than progressive except for *Flower*. But the comparison is done between different formats, and progressive display is generally more pleasant than interlaced. A subjective evaluation is thus required.

It is noticeable that *Renata* shows the largest difference with 2 dB more for interlaced which can be considered significant compared to the other differences (around 1 dB).

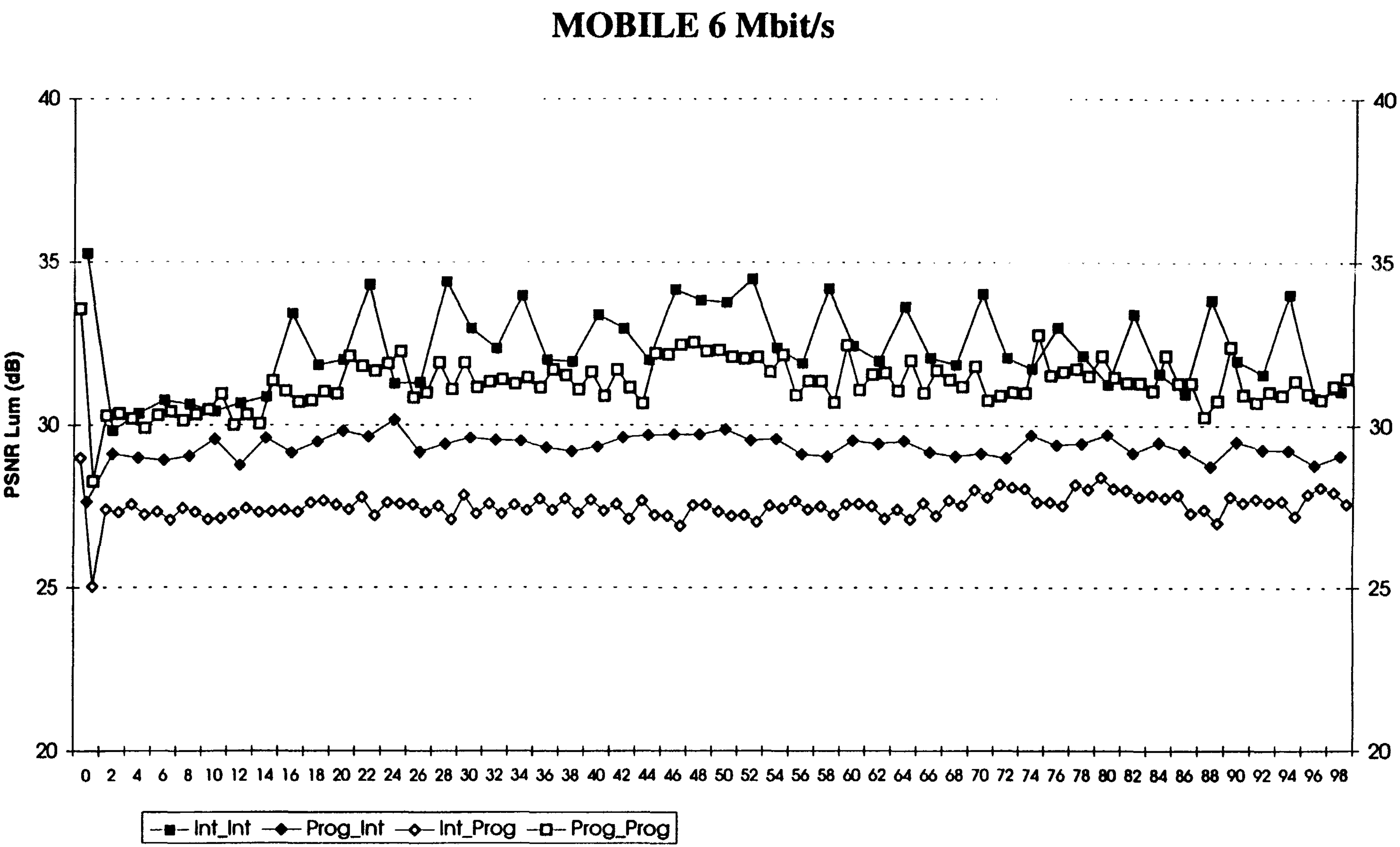


Fig. 10 - PSNR (dB) of MOBILE at 6Mbit/s, for both interlaced and progressive formats

FLOWER 4 Mbit/s

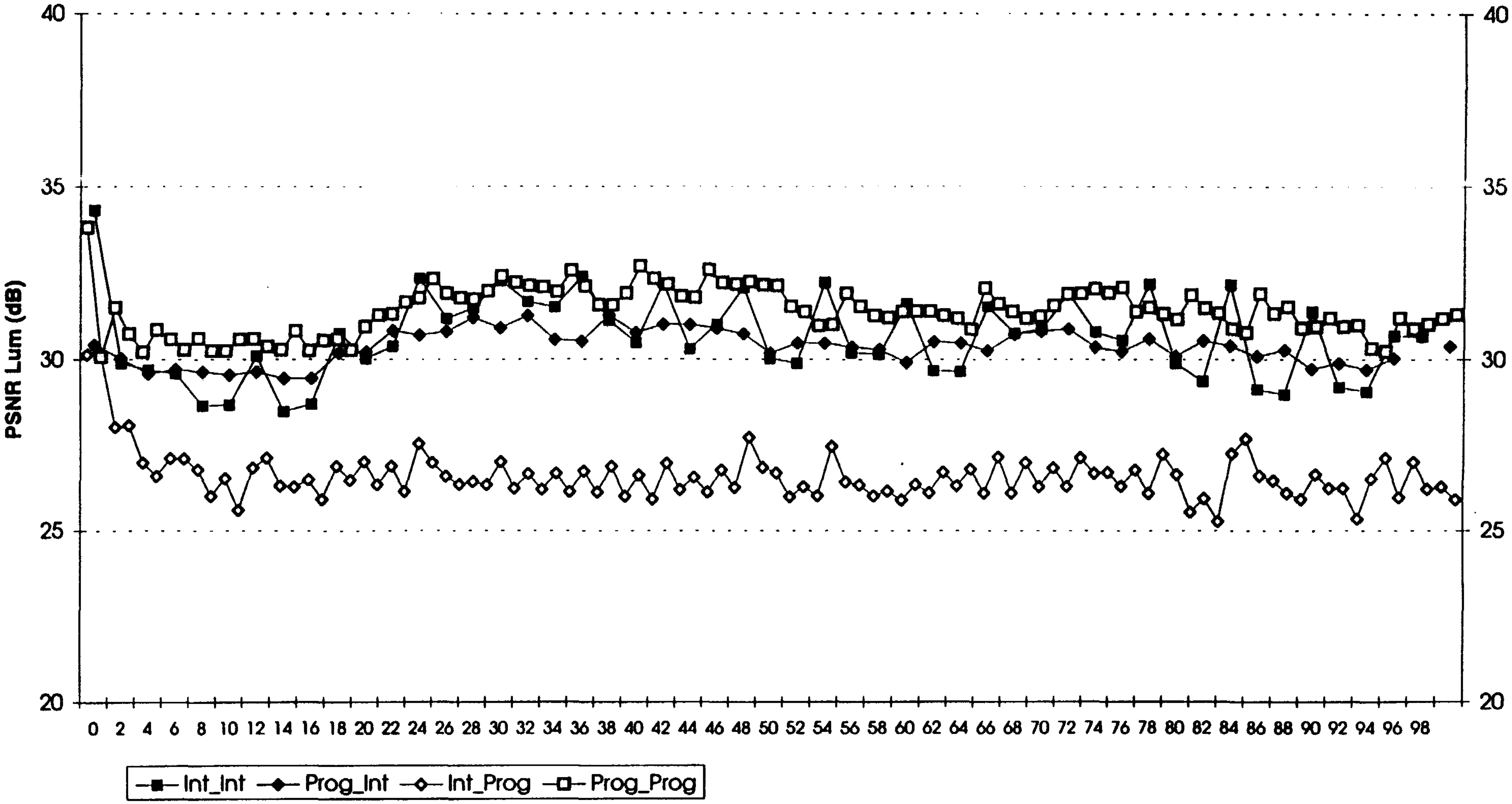


Fig. 11 - PSNR (dB) of FLOWER at 6Mbit/s, for both interlaced and progressive formats

KIEL 4 Mbit/s

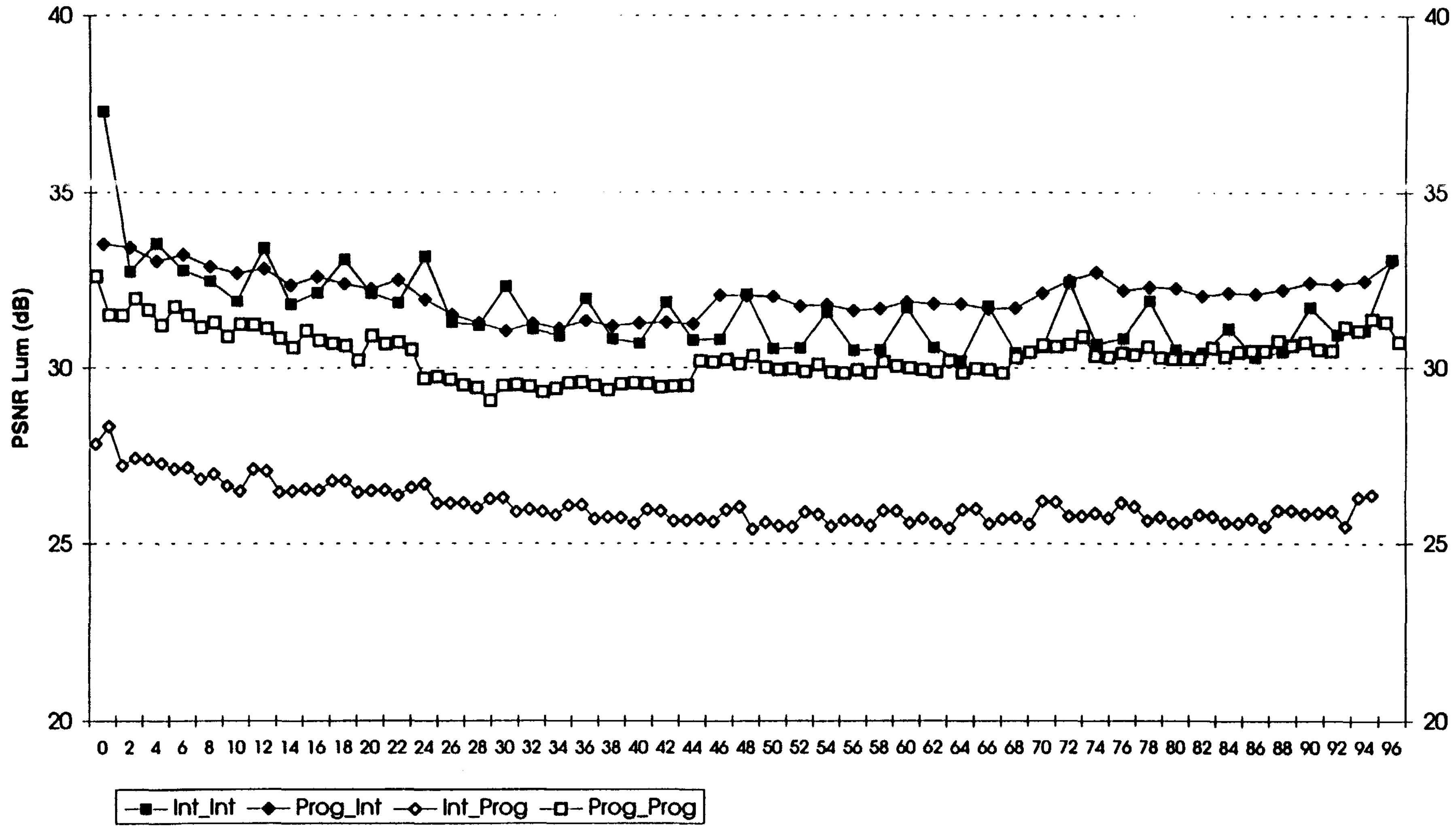


Fig. 12 - PSNR (dB) of KIEL at 4Mbit/s, for both interlaced and progressive formats

RENATA 4 Mbit/s

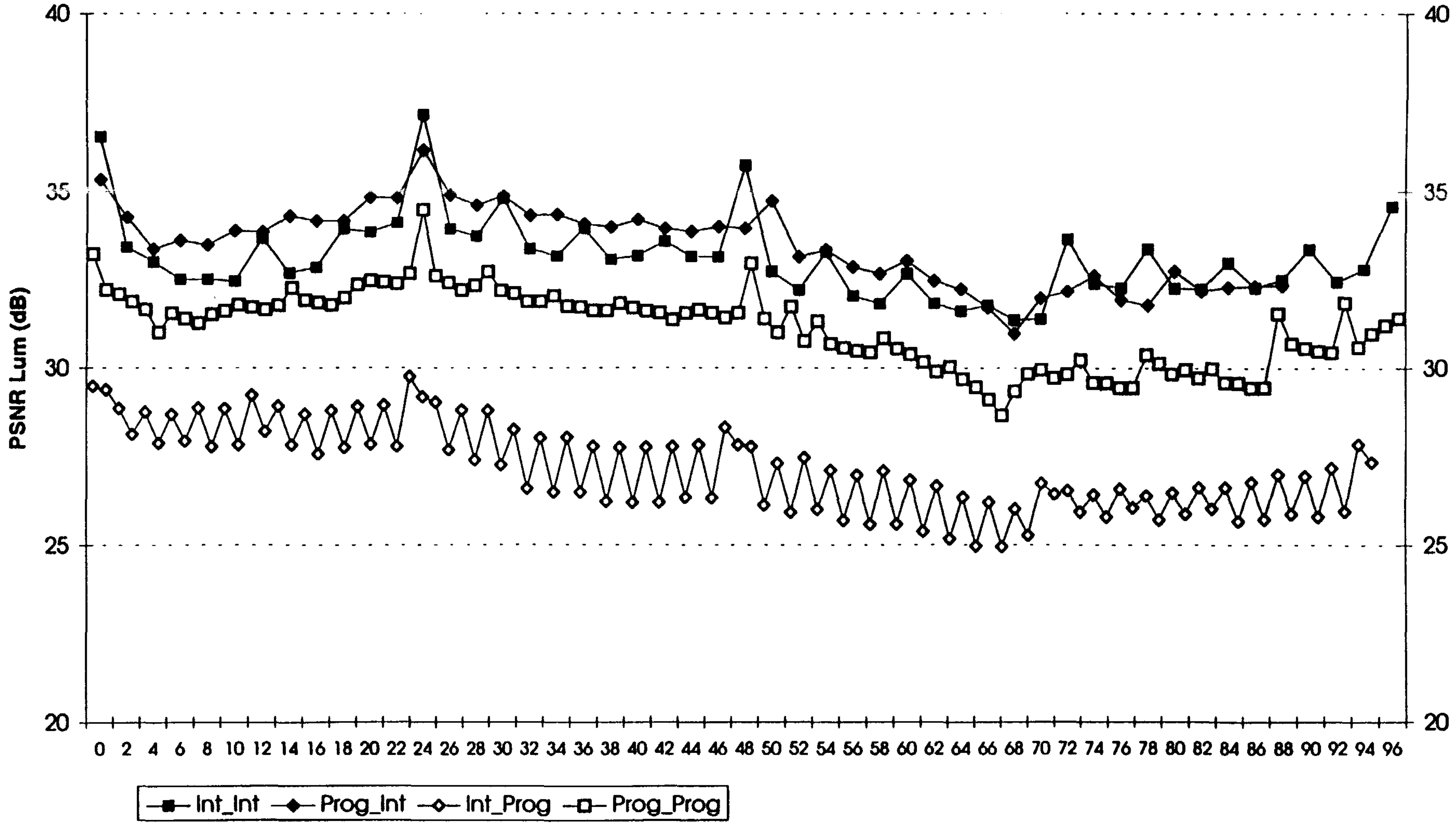


Fig. 13 - PSNR (dB) of RENATA at 4Mbit/s, for both interlaced and progressive formats

5.2.2 Subjective tests

The subjective picture quality evaluations were done on 2 different monitors : an interlaced one (SONY BVM 2010 P) and a progressive one (BARCO CC1D 120 T), both of them using a Trinitron tube. Moreover, comparisons between the same formats were done with the same monitor, whereas comparisons between different formats were done on the two different screens. Because of this unavoidable drawback, the conclusions must be drawn carefully.

Considering that the PSNR values are quite conform, or at least coherent, with the picture quality, the following contents the analysis performed on the four first sequences with both measures. The comparisons concern three scenarii : First the whole progressive chain facing the whole interlaced one (*Prog_Prog / Int_Int*), then the progressive transmission versus the interlaced one with interlaced display (*Prog_Int / Int_Int*), and finally the interlaced transmission versus the progressive one with progressive display (*Int_Prog / Prog_Prog*).

- ***MOBILE*** : *Prog_Prog/Int_Int* : The coding artifacts are slightly more visible in the progressive pictures, but the absence of effects due to the interlaced scanning (in particular in the calendar and sheep) leads to a progressive picture slightly more pleasant than the interlaced one (the PSNR is 1dB lower for progressive, cf. Table 6).

  Prog_Int/Int_Int : Even if the coding artifacts are similar, the loss of resolution in the progressive case (probably due to the kell filter) leads to a better interlaced chain (3dB loss for progressive, cf. Table 4).

  Int_Prog/Prog_Prog : It will be the same conclusion for the whole set of sequences within this scenario, the poor quality of the macroblock-based deinterlacer can not be compared to the progressive neither interlaced broadcasting chain.

- ***FLOWER*** : *Prog_Prog/Int_Int* : The interlaced format leads to visible artifacts such as blocking effects in the sky, line flicker in the tree or in the house edges. Borders of moving objets are also damaged. Thus progressive broadcasting is better than interlaced (the PSNR is 0.8dB better for progressive, cf. Table 6).

  Prog_Int/Int_Int : In addition to the previous considerations, a loss of resolution in the progressive case appears (once again probably due to the kell filter) but the overall quality is still a little better for progressive (the PSNR is 0.3dB lower for progressive, cf. Table 4).

Int_Prog/Prog_Prog : The poor quality of the deinterlacer is obvious with a line structure created on the flowers and the foreground tree.

- ***KIEL*** :

Prog_Prog/Int_Int : Progressive processing of Kiel removes the flicker due to the interlaced scanning (in the water, shrouds, and wharf) to give a more pleasant picture, but the coding artifacts are masked by the flicker in the interlaced case, then the overall picture quality is comparable with a small advantage to the progressive format (PSNR 1.3dB lower).

Prog_Int/Int_Int : The Kell-filtering of the progressive pictures reduces the blocking effect, thus progressive coding leads to a better picture quality (PSNR 0.5dB better).

Int_Prog/Prog_Prog : See previous sequences.

- ***RENATA*** :

Prog_Prog/Int_Int : Similar conclusions as for Kiel : no flicker in moving parts and better resolution in fixed areas for progressive, coding artifacts less visible for interlaced. But in this case the advantage is in favor of the interlaced format (PSNR 2dB lower in progressive).

Prog_Int/Int_Int : Once again, the Kell filtering decreases the visibility of the artifacts, but not enough to be better than interlaced in slow moving areas. The two formats are similar (PSNR 0.4dB lower for progressive).

Int_Prog/Prog_Prog : See previous sequences.

Then from the previous analysis, five remarks can be made :

1)- As expected progressive display is more pleasant than interlaced, mainly because of the absence of flicker;
2)- This flicker masks the coding artifacts which can become visible in progressive;
3)- Progressive coding and interlaced display can improve the picture quality compared to progressive display thanks to the Kell filter which acts as a post-filtering;
4)- The same Kell filter decreases the resolution of an interlaced source sequence (probably because the bandwidth of the Kell filter used for progressive to interlaced conversion is lower than that of real interlaced cameras);
5)- The Macroblock-based deinterlacer is not acceptable, a line structure in the borders of the macroblock is too annoying. It can be improved by using the surrounding macroblocks, but it will not be as good as interlaced scanning without careful design of the deinterlacer.

And the following conclusions can be pointed out :

1)- If an all progressive chain is compared to an all interlaced one, progressive is generally preferred to interlace, mainly due to the display;
2)- If interlaced display is used, progressive transmission can improve the picture quality if progressive sources are used, and the loss of resolution with interlaced sources can supersede the reduction of blocking effects. Finally similar performances between each coding format are achieved.

5.2.3 Bit-Rate Control Parameters

Besides the coding efficiency, the bit-rate control parameters have been processed for the whole progressive and interlaced chains. The results are plotted in figures 14 to 17 for the respective source sequences. For each one, the right side of the page is dedicated to the progressive chain and the left side to the interlaced one. On the upper graph the PSNR is drawn together with the bit-rate, for each frame and in the display order. On the lower graph, it is the buffer occupancy together with the quantizer step size, for each frame and in the coding order.
For these two graphs one curve is linked to the picture quality (PSNR or quantization step) the other one to the bit-rate (bit-rate or buffer fullness).

The main conclusion from these figures is that progressive transmission leads to a more stable bit-rate control, and thus to a more homogeneous picture quality.

To draw conclusions between an all progressive and an all interlaced broadcasting chain is difficult because subjective evaluation between different formats is not an easy task. In addition, one of the point this deliverable has to study is the use of progressive as an intermediate transmission format. For that purpose, complementary results are needed such as the influence of the bit-rate, i.e. is a format better at a given bit-rate and worse at another one? Similarly, what is the effect of a deinterlacer in the coding efficiency? Are the conclusions dependent on the picture complexity? All these questions are the subject of the next chapter.

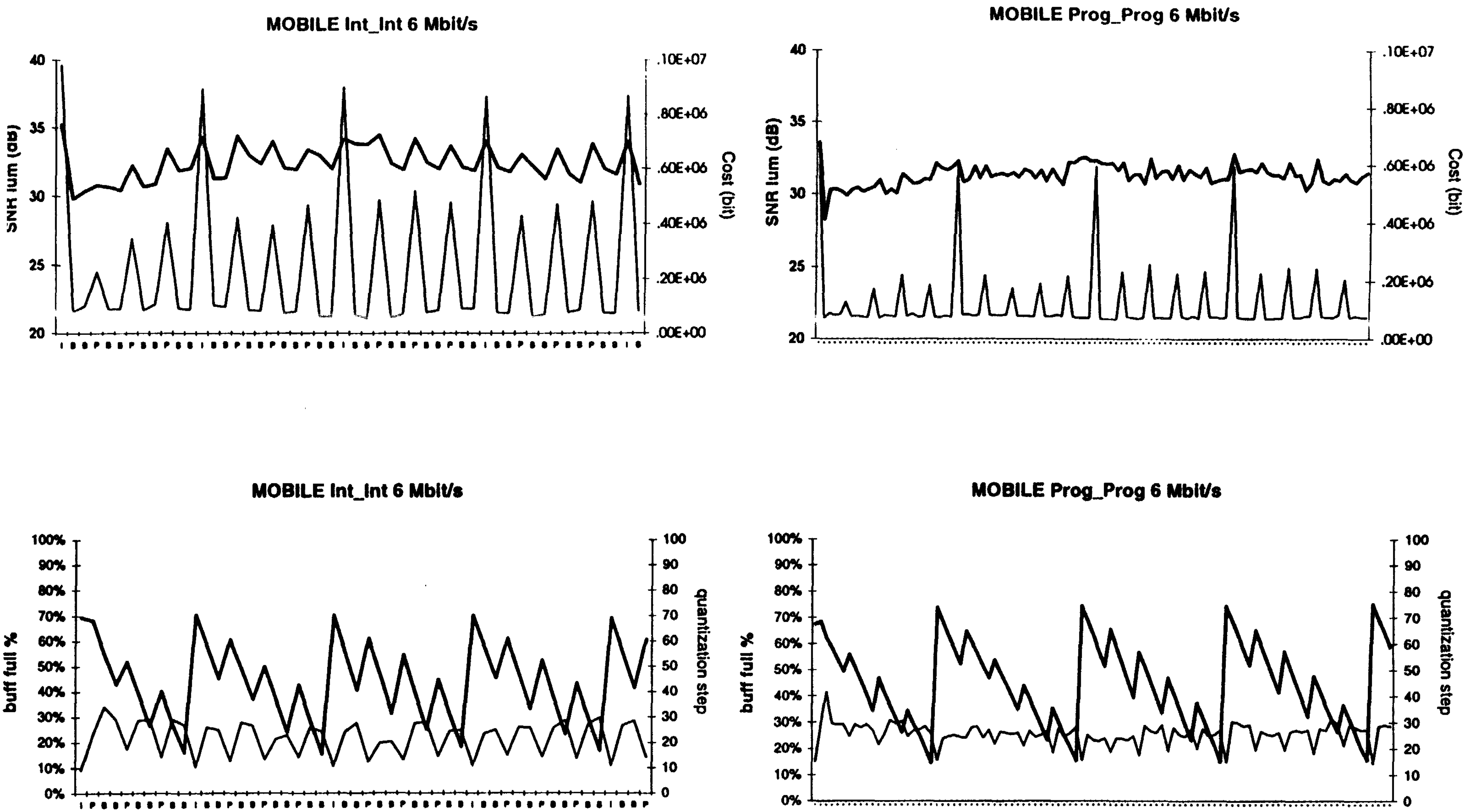


Fig. 14 - Bit-rate control parameters of MOBILE at 6Mbit/s for both progressive and interlaced encoding

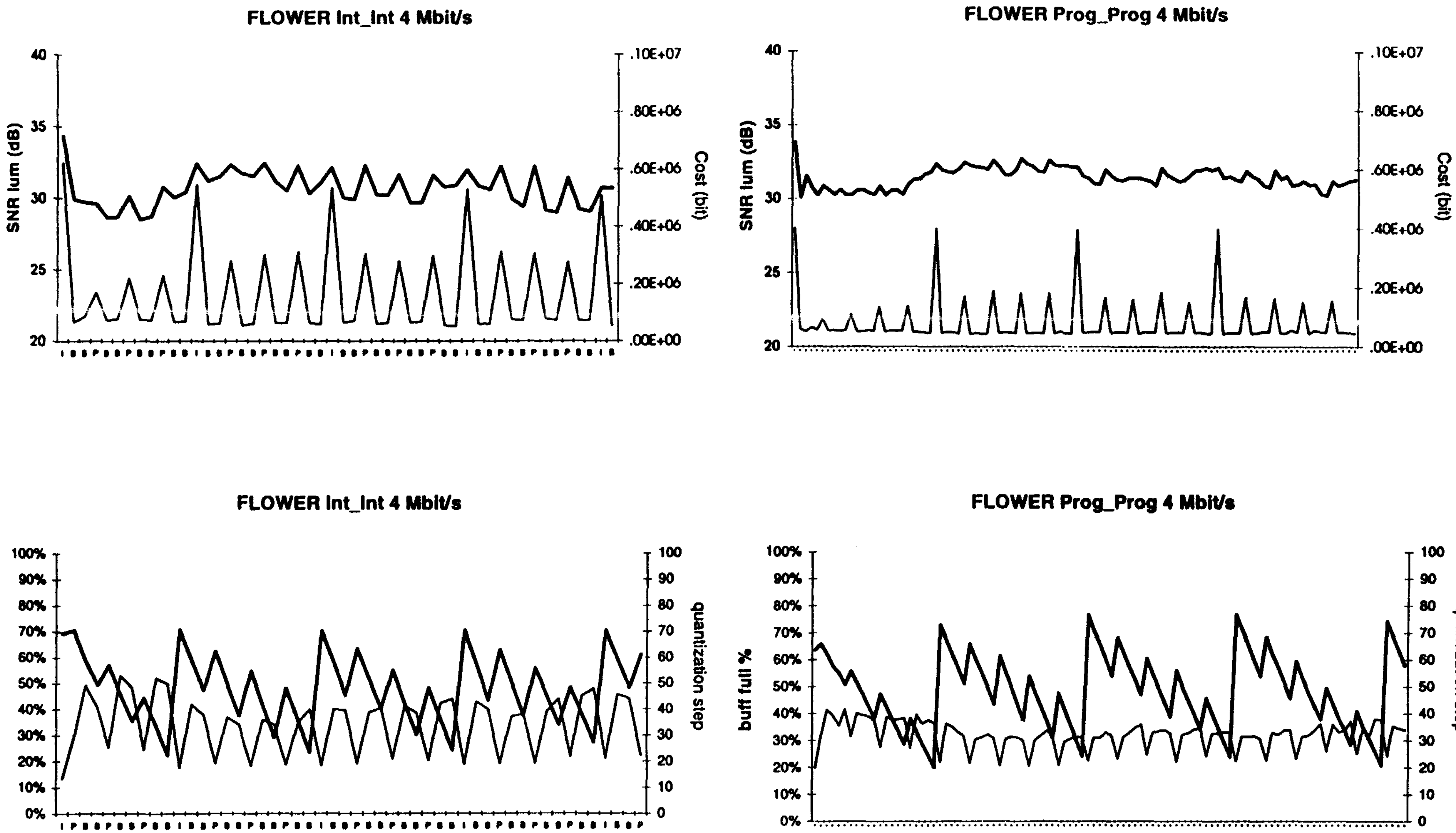


Fig. 15 - Bit-rate control parameters of FLOWER at 4Mbit/s for both progressive and interlaced encoding

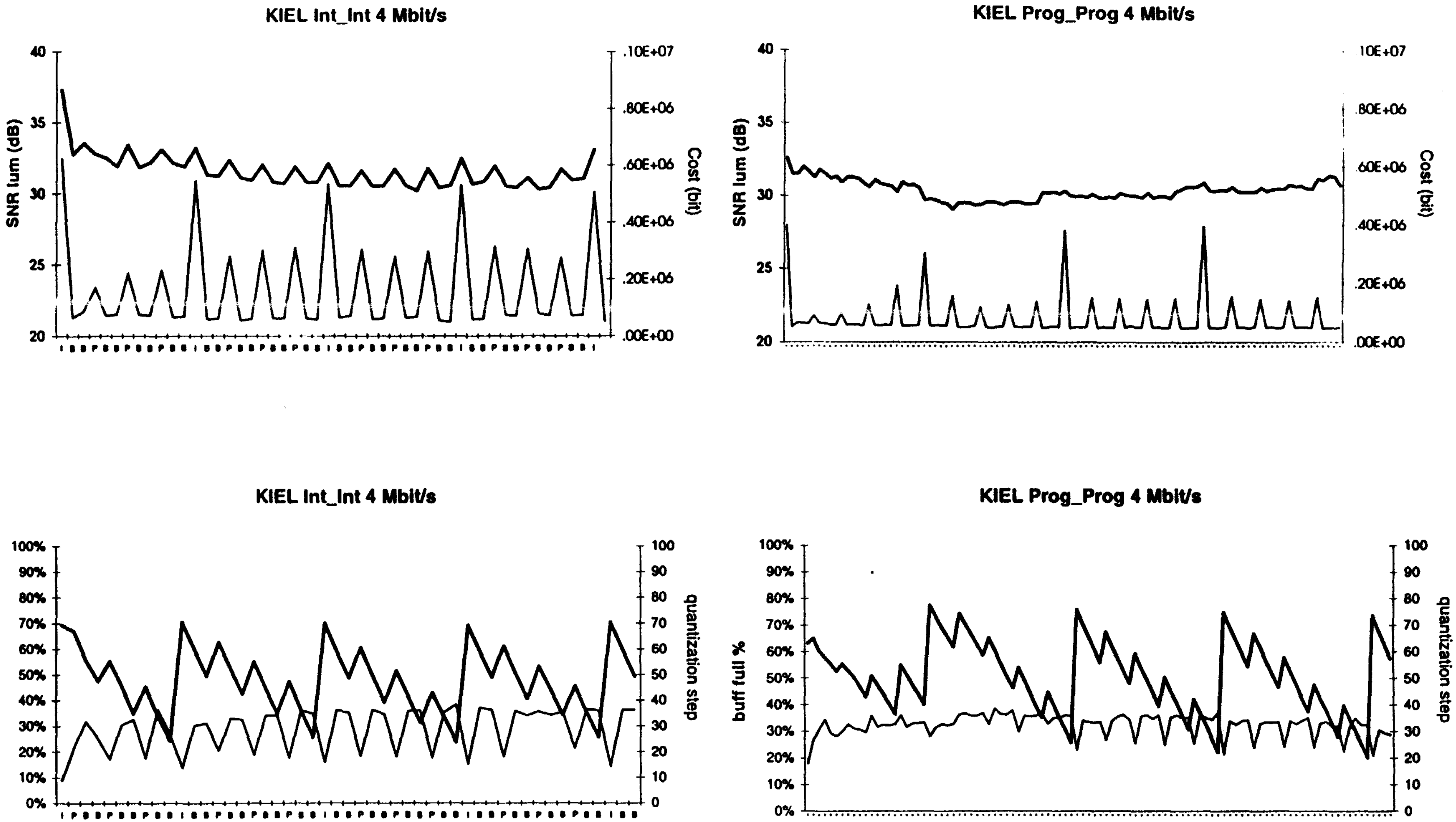


Fig. 16 - Bit-rate control parameters of KIEL at 4Mbit/s for both progressive and interlaced encoding

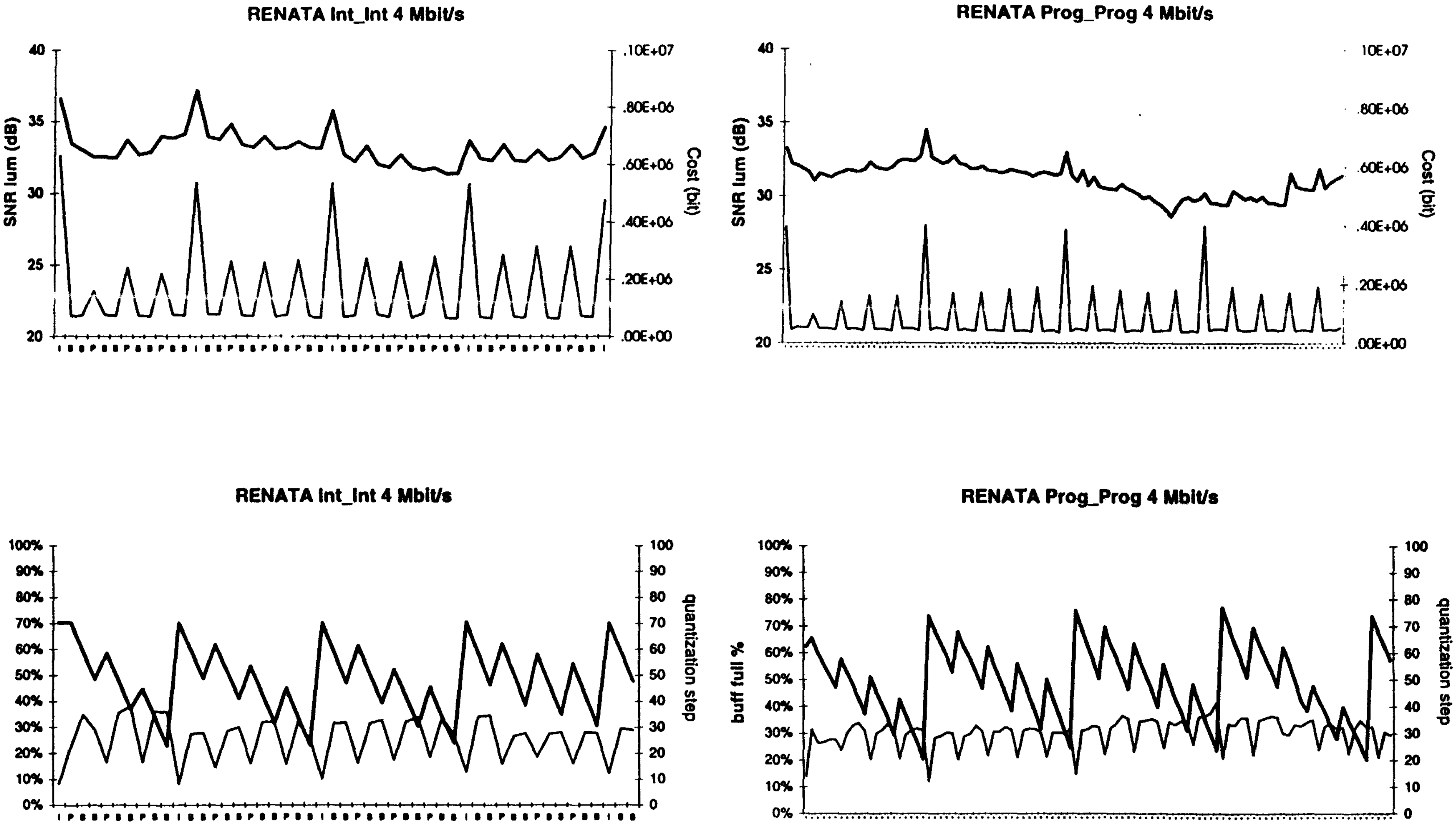


Fig. 17 - Bit-rate control parameters of RENATA at 4Mbit/s for both progressive and interlaced encoding

5.3 Influence of the Bit-Rate

Is the results of the comparisons between progressive and interlaced scanning dependent on the bit-rate? To answer this question, simulations on the sequence *Pops* have been performed at 2, 4 and 6 Mbit/s. Results in table 7, clearly show that if interlace is better at high bit-rates this is still true at low ones if not even more (the difference between both formats is 0.60 dB at 6 Mbit/s and increases up to 1.7 dB at 2 Mbit/s).
The number of pels as well as the vertical and horizontal resolution are very critical at low bit-rates, and, even with interlace, prefiltering is often required to smooth the picture content. If at high bit-rates the increased vertical resolution can be compensated, it is not true at low ones. It can also be supposed that for some sequences progressive can be better at high bit-rates and worse at low ones (to be confirmed).

Bit-rates	2 Mbit/s		4 Mbit/s		6 Mbit/s	
Coding Format	Prog	Int	Prog	Int	Prog	Int
PSNR (dB) Y	32.17	33.87	36.35	36.99	37.98	38.58
PSNR (dB) U	...	...	...	...	...	...
PSNR (dB) V	...	...	...	...	...	...

Table 7 - PSNR (dB) at different bit-rates

5.4 Influence of the Picture Complexity

From chapter 4, it seems that the conclusions differ depending on the picture content. Table 8 and figure 18 sum up the previous results by decreasing order of complexity value (in dB). The PSNR can be considered related to the difficulty to encode a picture, thus it is selected as complexity measure (a high complexity gives a low value).
From table 8 and figure 18, progressive performs clearly better for complex images and a little worse for pictures with a low complexity. The reason is that for a low complexity the picture is homogeneous, thus the progressive format bring no additional information compared to interlace. Since twice the number of lines should be transmitted it results in slightly lowering the PSNR of the decoded pictures. However, since the gap is nearly equal to 0.5 dB, and since both progressive and interlaced PSNR are high, no noticeable difference between both formats can be seen.

	Kiel 2 (28dB)		Foot (31dB)		Kiel (32dB)		Renata (33dB)		Pops (36dB)		Pendel (41dB)	
Coding Format	Prog	Int	Prog	Int	Prog	Int	Prog	Int	Prog	Int	Prog	Int
PSNR (dB) Y	29.17	27.81	32.23	30.84	32.11	31.61	33.49	33.14	36.35	36.99	41.25	41.87
PSNR (dB) U	...	...	..	...	39.08	39.23	36.07	35.69	...	...	...	...
PSNR (dB) V	...	...	..	...	37.82	38.00	37.86	37.67	...	...	...	...

Table 8 - PSNR (dB) for different picture complexity

These values are drawn in figure 18, and an interpolated curve tries to generalize the behavior of the gap between interlaced and progressive versus the complexity of the source sequence. The complexity is given by the mean PSNR of the decoded pictures in interlaced and progressive format. From this curve it seems that the threshold when interlaced becomes better in term of PSNR than interlaced is around 34, 35 dB (to be confirmed with more simulations).

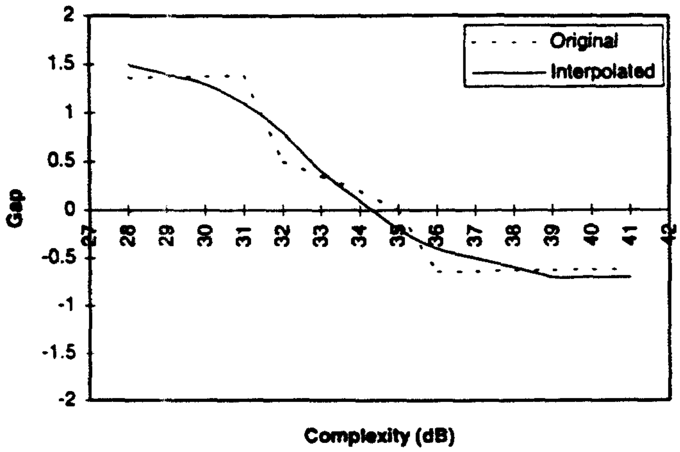


Fig. 18 - Difference between interlaced and progressive coding versus complexity

Moreover, the two extremities of the curve seem to have a behavior similar to an asymptote, it means that the maximal gap values are limited to around [+1.5, -0.5].
It should also be pointed out that the previous results are related to progressive source sequences, and in the case of deinterlaced pictures the conclusions are probably different due to the effect of the deinterlacing process.

5.5 Influence of the Deinterlacing

Moving towards progressive transmission will require conversions from progressive to interlaced and interlaced to progressive scanning to manage present studio environment. Thus the effects of the deinterlacing have to be studied to be sure that it handles field aliasing properly.
Table 9 depicts the results of simulations performed on the Kiel 2 progressive source sequence. The original pictures are progressive encoded and interlaced displayed to give the PSNR value called *progressive* in table 9, this sequence is then interlaced coded and displayed, and its PSNR computed in column *interlaced* (this PSNR refers to the original sequence that has been interlaced). Finally, the previous sequence is *deinterlaced* to go back to progressive coding.
As expected, the deinterlaced sequence is better than the interlaced one, because the original progressive source pictures perform already better than the interlaced version, and because the deinterlacing is artifacts free on that sequence.

Coding Format	Progressive	Interlaced	Deinterlaced
PSNR (dB) Y	29.17	27.81	28.36
PSNR (dB) U	...	...	...
PSNR (dB) V	...	...	...

Table 9 - PSNR (dB) between interlaced, deinterlaced and progressive signals

These results are very dependent on the quality of the deinterlacer, thus conclusions may take into account possible low quality deinterlacing. However, it can be assume that future deinterlacing will become better and better.

6 - Conclusion

In this deliverable, the coding efficiency of both progressive and interlaced scanning formats are compared by means of PSNR values and subjective picture quality analysis. The main goal was to evaluate the impact of using a progressive transmission format compared to the existing interlaced one.

It was demonstrated in the first part that there is a raw factor of 1.1 to 1.7 between the bit-rate required for the transmission of progressive and interlaced pictures with the same quantizer step size and non-optimal GOP structure. It means that a progressive format allows to transmit twice the number of lines with less than twice the bit-rate. The second part leads to the conclusion that the absence of interlaced artifacts (mainly line flicker) and the use of an optimal GOP structure allows the use of a greater compression factor in the case of progressive processing and display. At the same bit-rate an all progressive broadcasting chain, from the source capture to the final display, is thus preferable to an all interlaced one, except for an increased hardware complexity since twice the number of pixels is scanned.
Moreover, with interlaced display, the progressive transmission can be considered at least as good as the interlaced one and better if progressive sources are encoded (the degree of improvement is linked to the complexity of the source material, the higher the complexity the bigger the improvement is). Unfortunately, the conclusions are not so clear when dealing with interlaced sources : the loss of resolution supersedes sometimes the reduction of blocking effects and the conversion from progressive to interlaced scanning after decoding can either improve (post-filtering of the coding artifacts) or decrease (loss of resolution) the picture quality depending on the source sequences available. Consequently, it has been shown that progressive does not lead to a loss of performances, that on the contrary it brings a more stable picture quality, even if the MPEG-2 standard has been optimized for interlaced signals.

Thus, from a picture quality point of view, progressive scanning is a very attractive format for the transmission, and even more for the visualization of pictures. In addition, progressive can be used as an intermediate step towards progressive broadcasting of TV signals without loss of performances compared to the existing interlaced format.
Finally, with such a broadcasting format compatibility with the multimedia applications (Computer, broadcasting, transmission, virtual, film, ...) will be simplified and more efficient.

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